

Training, Nutrition, and Sports Supplement Strategies of an Elite Female Masters Cyclist: A Case Study

Case Study

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Abstract

Background: The purpose of this case report was to compare the training, diet, and supplement strategies of a 54-year-old female national-class cyclist to what is typically recommended in the literature.

Methods: This case study examined the training, nutrition, and supplement strategies of a 54-year-old Masters female cyclist who won the 2023 USA Cycling Time Trials. Data was acquired via a smartwatch that the athlete wore in all of her training sessions over 29 weeks, outlining the volume of training as well as macronutrient and supplement consumption.

Results: Her average weekly training volume was 167.0±61.4 miles (268.8±98.8 km; mean ± standard deviation [SD]). The number of training sessions per week was 8.4±2.1. In addition, the percentage of the weekly training sessions that consisted of high-intensity interval training was 55.3±20.1 %. Her mean energy intake was 2444±101 kcal or 36.6 kcal/kg. Her macronutrient intake was 228±33 grams (g) of carbohydrate, 95±34 g of fat, and 196±25 g of protein. Expressed per unit body weight daily (kilograms or kg), her macronutrient intake was 3.3 g/kg carbohydrate, 1.4 g/kg fat, and 2.9 g/kg protein. After 29 weeks of training, the athlete won first place in the 30k USA Cycling Time Trial (Masters) with an average speed of 23.35 miles per hour (37.6 km/hr.).

Conclusions: The results highlight that for this particular female athlete, consuming a high-protein diet coupled with a moderate intake of carbohydrates is a viable strategy for endurance events (e.g., cycling time trials). It should also be noted that the majority of her training sessions consisted of interval training.

Key Words: endurance, periodization, high protein

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Introduction

This case study examined the training, nutrition, and supplement strategies of a 54-year-old Masters female cyclist who won the 2023 USA Cycling Time Trials over the course of 29 weeks.

Periodization

Periodization is a training concept that involves dividing an athlete's training program into distinct phases or periods, each with a specific goal and focus^{1,2}. A systematic review of seven studies by Galan-Rioja et al.³ found that block periodization (which involves highly concentrated training workload phases) improved maximum oxygen uptake, peak aerobic power, lactate, and ventilatory thresholds in trained cyclists. Another study reviewed by Galan-Rioja found that periodization effectively improved athletic performance in masters cyclocross athletes³. These favorable physiological adaptations would purportedly increase the chances of success for endurance athletes.

Macronutrient

Considerations

Nutrition, hydration, and recovery strategies are important for supporting their performance during long rides and training. The energy and macronutrient needs of endurance cyclists can vary depending on an individual's body weight, as well as training intensity, duration, and frequency of their rides. According to the International Society of Sports Nutrition, athletes engaged in high-volume training should consume 40–70 kcal/kg/day to counteract high energy expenditure⁴. In addition, the Academy of Nutrition and Dietetics (AND), the ISSN, and the American College of Sports Medicine recommend 6-10 g of carbohydrate (CHO)/kg/d for endurance athletes^{4,5}. Endurance athletes are defined as those regularly engaged in 1-3 h/d moderate to high-intensity exercise⁵. Carbohydrate recommendations are even higher (8–12 g of CHO/kg/day) for ultra-endurance athletes (4-5 h/d moderate to high-intensity exercise)^{4,5}. These recommendations are in line with those put forth by Burke et al. for road cyclists⁶ (Table 1).

Table 1. Recommendations by Burke et al.

Time	Recommended CHO Intake
Pre-race/prolonged training session (1-4 hours before)	1-4 g/kg BM
Intra-session (lasting >60 min)	0.5-1.0 g/kg BM/h or (30-60 g/h)
Post-race/training recovery with >8 hours between sessions	1 g/kg BM for 2 hours post-exercise
Optimal Daily Intake	7-12 g/kg BM/d

Endurance athletes tend to focus on carbohydrate intake; however, protein is essential for recovery and maintenance of lean body mass⁴. Athletes require protein intakes that exceed the general population's (0.8 g/kg/day). The ISSN recommends 1.4–2.0 g/kg/day⁴. The timing of protein intake is less important than the total daily intake; however, spacing protein throughout the day aids in meeting the athlete's daily protein goal. Fat intake for an athlete should range between 20-35% of total daily calories^{4,5,7}. Similar to nutrient recommendations for the general population, no more than 10% of daily calories should come from saturated fat⁵. There is growing interest in high fat diets among endurance athletes. Fat oxidation is greater than glucose oxidation at low-intensity exercise, which is characteristic of endurance sports. However, high-fat/low-carbohydrate diets are not conducive to sports performance and are not recommended for the competitive athlete^{4,7}.

Polarized Training

Recent research has presented compelling evidence supporting adopting a polarized cardiovascular endurance training model as a viable alternative to traditional training approaches⁸⁻¹⁰. The polarized training model focuses on "light" and "very hard" paces. The "light" pace, zone 1, comprises about 80% of the training volume. The "very hard" pace, zone 3, comprises about 20% of the training volume. Training zones are often defined regarding heart rate or blood lactate concentration ranges¹¹. The emergence of a polarized training model is rooted in a limited yet significant body of research involving observations of high-caliber rowers¹², gold medal-winning time-trial cyclists¹³, and internationally elite marathoners¹⁴. These studies indicate that, at high-performance levels, athletes tend to train predominantly below the lactate threshold intensity, or zone 1, constituting approximately 75% of their sessions or training distance. Conversely, approximately 15–20% of the time is dedicated to training well above the lactate threshold intensity (e.g., high-intensity interval training or HIIT).

Stoggl & Sperlich⁹ investigated the effects of different training concepts on key endurance performance variables in well-trained athletes⁹. The four training approaches examined were high-volume training (HVT), lactate threshold training (THR), high-intensity interval training (HIIT), and polarized training (POL). Polarized training, combining HVT and HIIT, demonstrated superior improvements in peak oxygen uptake (VO_{2peak}), time to exhaustion, and peak velocity/power compared to other methods⁹. THR and HVT did not lead to significant performance improvements. Additionally, body mass decreased by 3.7% following HIIT. The findings suggest that polarized training might be more effective in enhancing endurance performance in well-trained athletes than other commonly used training concepts.

According to the Dietary Supplement Health and Education Act of 1994¹⁵, the term "dietary supplement" is defined as a vitamin, mineral, herb or other botanical, an amino acid(s), a dietary substance for use by man to supplement the diet by increasing the total dietary intake; or a concentrate, metabolite, constituent, extract, or combination of any ingredient." Regarding dietary supplement use in endurance athletes, several may be of benefit (e.g., caffeine, creatine, beta-alanine, and carbohydrate). Caffeine is one of the most beneficial and widely used by endurance athletes¹⁶⁻¹⁸. Caffeine in doses of 3-6 mg/kg of body mass has consistently improved endurance performance from 2% to 4% in

several research studies¹⁸⁻²³. The benefits of caffeine were reported in several endurance sports, including running²⁴⁻²⁶, cycling^{22,27,28}, swimming²⁹, and cross-country skiing³⁰. Potential ergogenic benefits from creatine supplementation in endurance events include greater tolerance to training, enhanced recovery³¹, enhanced glycogen synthesis, enhanced aerobic capacity due to a greater capacity to shuttle adenosine triphosphate (ATP) from the mitochondria, and an increased capacity for work³². Creatine is an organic molecule that is endogenously produced in the body. It has been shown to possibly increase tolerance to exercising in the heat, which is also beneficial to endurance training³³. Beta-alanine has consistently demonstrated benefits versus placebo in studies looking at time to exhaustion (TTE), which benefits endurance athletes³⁴⁻³⁹. Beta-alanine has also been reported to decrease trial times in endurance rowing trials⁴⁰. It has also been shown to reduce neuromuscular fatigue in cyclists^{39,41}. Carbohydrate supplementation for endurance athletes can greatly benefit their performance⁴². In long-distance female runners, carbohydrate availability was increased with carbohydrate supplementation⁴³.

Methods and Results

Participants

This investigation was a case report on a 54-year-old female masters cyclist who worked directly with a cycling coach and a sports nutritionist during her training period.

Protocol

The athlete kept a digital diary of her training, nutrition, and supplementation. This was tracked over a 29-week period. The following data was collected via her smartwatch and the mobile app, MyFitness Pal. Regarding training, her smartwatch collected the distance, speed, and intensity (i.e., watts) of her cycling training. In addition, she tracked her diet at least three times per week over 29 weeks using the MyFitnessPal mobile app.

It is notable that the athlete was a well-accomplished distance runner at a division 1 university (Table 2) and a duathlete (~ 25 years after college). Nonetheless, the transition from distance running to cycling took many years, and it was not until 2020, approximately 30 years after college, that she exclusively trained and raced in cycling events (Table 3).

Table 2. Brief history – distance running and duathlons.

Won the Missouri Valley Conference Cross Country Individual Championship in 1988 and 89
Qualified for NCAA Division I National Cross Country Championships, 1989
Named to Missouri Valley All-Decade Team (1989-99) for Cross Country
Awarded Drake Double D Award, 2006 (Award given to Drake letter winners for achievement in their chosen field after graduation)
Named to Missouri Valley ‘All-Time Cross Country Team’, 2007
All-American age group Duathlon 2021 and 2022

Table 3. Cycling performance.

2020: 3rd Place State Florida TT* - 20k (Age Group): 22.7mph
2021: 1st Place Florida State TT - 20k (Age Group) 23.3mph
2021: 1st Place Florida State Gravel- 56 miles
2022: 1st Place Florida State TT - 20K (Age Group) 24.1mph
2022: 1st Place Gravel Worlds - 78 miles (Age Group)
2023: 1st Place Florida State TT- 20k (Age Group) 25.09mph
2023: 1st Place 5K National Senior Games (Age Group) 25.47mph
2023: 1st Place 10K National Senior Games (Age Group) 25.75mph
2023: 1st Place 30K USA Cycling National TT (Age Group) 23.35mph

Note: *The subject’s first cycling race was the Florida state time trial in December of 2020. The age group is 50-54 years.

Body Composition

The athlete (54 years, 170.2 cm height) has been weight-stable for over a decade. Her body composition, which was assessed via 7-site skinfolds, has not appreciably changed in several years (i.e., all data is expressed as the mean ± SD – body mass 148 pounds [67 kg], percent body fat 16.6%⁴⁴, fat mass 24.6 pounds [11.2 kg], lean body mass 123.4 pounds [56.1 kg]).

Diet and Supplementation

Energy intake

The athlete consumed 2442 ± 101 kcals daily (i.e., 36.4 kcal/kg or 43.5 kcal/kg fat-free mass).

Protein

Protein intake was in the range of 2.7-3.4 g/kg d with a mean intake of 2.9 g/kg/d; moreover, her mean carbohydrate intake was 3.3 g/kg/d, whereas her fat intake was 1.4 g/kg/d (Figure 1).

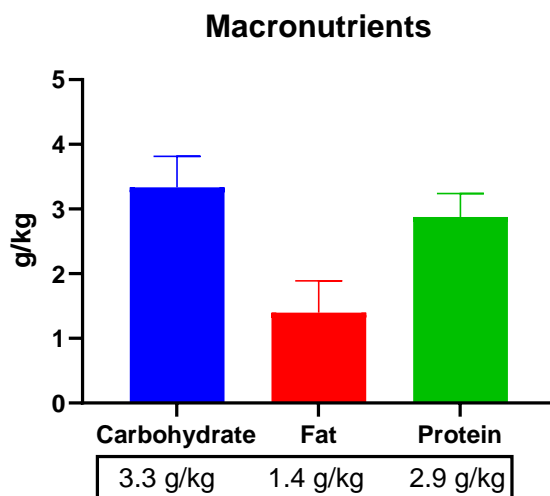


Figure 1. Macronutrient intake of the masters cyclist.

The athlete consumed a variety of dietary supplements (Table 4).

Table 4. Sports supplements

Creatine monohydrate 5 g/d

Beetroot 650 mg/d

Beta-alanine 2.5 g/d

Caffeine ~300 mg (usually pre-training)

Training Regimen

The training regimen (i.e., mileage, hours, and percentage of HIIT) is outlined in Figures 2-4.

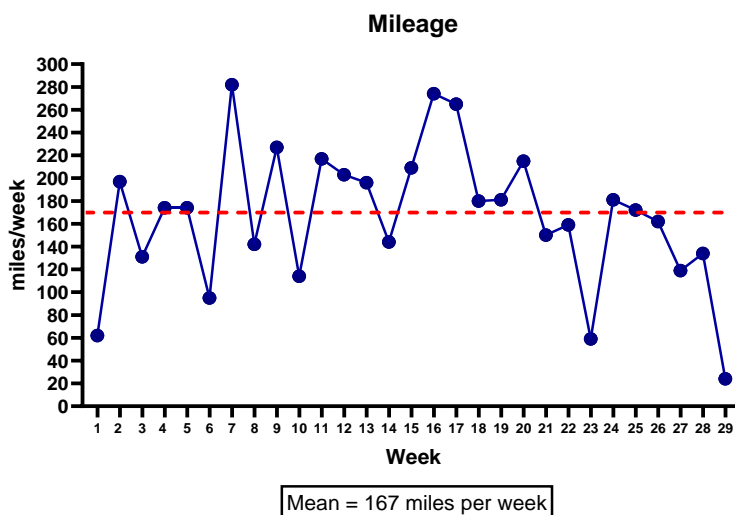


Figure 2. Training volume (miles per week) over 29 weeks. The red dashed line represents the mean.

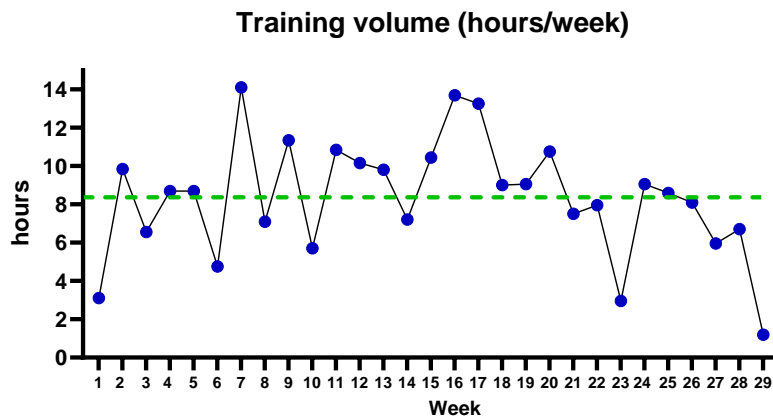


Figure 3. Training volume (hours per week) over 29 weeks. The green dashed line represents the mean.

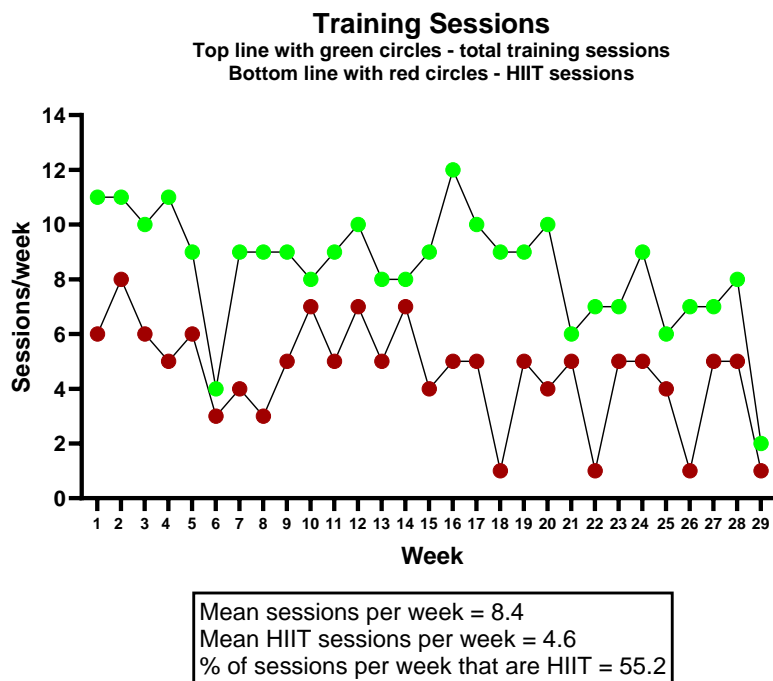


Figure 4. Training sessions per week over 29 weeks. The green circles represent the total number of training sessions. The red circles represent the total number of HIIT sessions.

Discussion

Training

The athlete consumed 2442 ± 101 kcals daily (i.e., 36.4 kcal/kg or 43.5 kcal/kg fat-free mass). Interestingly, this is slightly lower than the recommendations of Melin et al. and Robert-McComb et al. (i.e., >45 kcal/kg fat-free mass)^{45,46}. On the other hand, it is congruent with the work of Constantini et al. (i.e., 40-45 kcal/kg fat-free mass)⁴⁷. In addition, she adhered to a dietary regimen, as advised by her sports nutritionist, that deviated from the established literature. Her protein intake (range 2.7-3.4 g/kg daily) was, on average, 45% higher than the upper limit of the recommendations of the International Society of Sports Nutrition⁴⁸ (1.4-2.0 g/kg daily) as well as the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine (1.2-2.0 g/kg daily)⁴⁹. Phillips has suggested that a range of 1.2-1.6 g/kg daily is sufficient⁵⁰. Williamson et al. stated that “our findings indicate that endurance athletes consuming a daily protein intake toward the upper end of current consensus recommendations (~ 1.85 g/kg/d) will maximize whole-body protein synthesis during postexercise recovery regardless

of sex ⁵¹. On the other hand, Antonio has suggested that athletes consume at least 2.2 g/kg daily ⁵². The protein intake of this Masters cyclist more closely resembles the intake of highly trained male bodybuilders ⁵³. It has been suggested that carbohydrate intake for endurance performance range from 5 to 7 g/kg/d (i.e., for general training needs) and 7 to 10 g/kg/d, presumably for much higher volumes of training ⁵⁴. Furthermore, Deldicque and Francaux make sex-specific recommendations of >8 g/kg/d ⁵⁵. It is clear that this particular masters cyclist can compete at the highest level with a low to moderate intake of carbohydrates (Figure 1). In fact, her 3.3 g/kg/day of carbohydrates is less than half of the typical recommendations for endurance athletes. As a percentage of total energy intake, this Master athlete consumed approximately one-third of her calories from fat. This represents the upper end of what has been previously recommended ⁵⁶.

Her training regimen is neither polarized, pyramidal, or periodized. If one examines her training volume, whether as mileage or hours of training, it is evident that there is no pattern per se that looks periodized. At best, one can describe it as alternating between higher and lower volume on a weekly or bi-weekly basis. It is not until the final week of training prior to the 2024 USA Cycling National Time Trials that volume significantly decreases (i.e., a taper).

Polarized training is a method that emphasizes a balance between low-intensity, steady-state training, and high-intensity interval training (HIIT), with minimal time spent in moderate-intensity zones. In this approach, approximately 80% of training time is dedicated to lower-intensity training. On the other hand, the remaining 20% is allocated to high-intensity workouts such as HIIT. It has been posited that this training model allows for optimal physiological adaptations ⁵⁷. Conversely, Burnley et al. “argue that polarized training is, in fact, rarely practiced by elite athletes, and there is limited to no evidence that it is more effective than other training models ⁵⁸.” Accordingly, elite endurance athletes engage in pyramidal rather than polarized training ⁵⁸. Notably, the intensity distribution of pyramidal training involves a larger portion of training in Zone 2, which is non-existent in polarized training ⁵⁹. Prospective randomized-controlled trials have observed comparable enhancements in this distribution when compared to polarized training ⁶⁰ ⁶¹.

Contrary to the pyramidal and polarized models, the athlete in this case report engaged primarily in high-intensity interval training (i.e., > 50% was HIIT). It is evident that this training regimen is highly effective for the athlete inasmuch as she consistently places first in numerous cycling events. One might describe this training regimen as “balanced intensity training” to describe that 50% of it is interval training of varying intensities. In contrast, the other half is primarily steady-state aerobic training. At this point, it is evident that training programs should be adjusted to the type of athlete. It is unclear whether non-weight-bearing athletes (e.g., rowing, kayaking, canoeing, swimming, stand-up paddling, cycling, skating, etc.) should follow a regimen similar to runners (i.e., weight-bearing athletes). Furthermore, it is not known if an athlete engaged in a sport that is mainly upper body in nature (e.g., stand-up paddling) should engage in a similar program to one that is mostly lower body in nature (e.g., cycling). We believe that further research is necessary regarding sport-specific training programs.

Diet

Nutritional, hydration, and recovery strategies play pivotal roles in bolstering the performance of endurance cyclists during prolonged rides and training sessions. Tailoring energy and macronutrient intake to individual needs, including factors such as body weight, intensity, duration, and frequency of rides, is crucial. According to the International Society of Sports Nutrition, athletes undergoing high-volume training should aim for a daily intake of 40–70 kcals/kg to offset the heightened energy expenditure. ⁴ Furthermore, the Academy of Nutrition and Dietetics (AND), along with the ISSN and the American College of Sports Medicine, advocate for carbohydrate consumption ranging from 6-10 g/kg/day for endurance athletes engaged in 1-3 hours of moderate to high-intensity exercise ⁴⁵. Burke et al. [6, 7] have recommended carbohydrate intakes as high as 7-12 g/kg/body mass daily. This may not apply to all endurance athletes. At the low end, 7 g/kg would translate to 469 grams of carbohydrates, whereas at the high end, 12 g/kg would translate to 804 grams. That would be 1,876 to 3,216 calories in carbohydrates alone. The athlete, in this case, reports 2,442 calories daily. We would posit that a 7-12 g/kg/body mass carbohydrate intake is excessive and may result in a gain in fat mass. At the high end of the carbohydrate intake (i.e., 3,216 calories per day), that amount exceeds the total energy intake of the athlete by 774 calories. Indeed, if the athlete consumed 12 g/kg/body mass of carbohydrates daily, the likely result would be an increase in fat mass and a decrease in performance. Notably, the 3,216 calories do not include fat or protein.

While endurance athletes often prioritize carbohydrate intake, protein is equally indispensable for recovery and the preservation of lean body mass. According to Williamson et al., male and female endurance athletes should consume

~1.85 g/kg/body mass daily⁵¹. A position stand from the ISSN suggests a range of 1.4-2.0 g/kg/body mass daily⁶² whereas other reports suggest an even higher intake of ≥ 2.2 g/kg/body mass daily^{52,63}. The athlete, in this case report, consumed an average 2.9 g/kg/body mass daily.

Fat plays a vital role as a macronutrient for endurance athletes due to its numerous metabolic functions that contribute to optimal health. Endurance athletes are typically advised to consume fat within the range of 20-35% of their total daily caloric intake^{7,49}. The athlete in this report consumed ~35% of her energy intake as fat.

Supplements

The athlete consumed various supplements for recovery and performance (i.e., creatine monohydrate, beta-alanine, caffeine, protein, and beetroot). While traditionally associated with strength and power sports, emerging evidence suggests potential benefits of creatine supplementation for endurance athletes as well⁶⁴. Due to its capacity to improve anaerobic performance by enabling repeated bursts of high-intensity exercise, creatine supplementation could offer advantages in various sports, such as cycling⁶⁴. Beta-alanine supplementation has been shown to increase muscle carnosine levels, particularly in type II muscle fibers, which are predominant in activities such as sprinting and high-intensity cycling intervals. By enhancing buffering capacity, beta-alanine may allow cyclists to sustain higher intensities for longer durations, potentially improving overall performance in endurance events⁶⁵⁻⁶⁷. There is a plethora of data to support the use of caffeine as an ergogenic aid. For instance, the acute ingestion of 3 mg/kg body mass of caffeine enhanced peak and average power during a 15-second Wingate test⁶⁸. The position stand of the ISSN states that the recommended dose of caffeine is ~5 mg/kg body mass⁶⁹. Lei et al. found that consuming 6 mg/kg body mass of caffeine “stimulates breathing and aerobic metabolism, resulting in improved performance during incremental and high-intensity endurance exercises in moderate normobaric hypoxia⁷⁰.” Beetroot is rich in dietary nitrate, which can be converted into nitric oxide (NO) within the body. Nitric oxide plays a crucial role in vasodilation, improving blood flow and oxygen delivery to working muscles. Beetroot supplementation has been associated with enhanced exercise performance in cyclists^{71,72}.

Conclusions

This case report aimed to contrast the training, dietary, and supplement approaches of a 54-year-old female national-class cyclist with conventional recommendations in the literature. Over 29 weeks, data was collected on training volume, macronutrient intake, and supplement use. These findings suggest that for this particular national-class female masters cyclist, adopting a high-protein diet alongside moderate carbohydrate intake is effective for cycling time trials (i.e., she was 1st place in the 2023 30k USA Cycling TT). Additionally, the predominance of interval training sessions in her regimen is noteworthy in that it is not in agreement with the published literature on endurance training. Lastly, she regularly consumed sports supplements such as creatine, caffeine, beta-alanine, and beetroot. Future related studies should address whether endurance athletes need to be on a high-carbohydrate diet as well as the notion that they should limit their protein intake (e.g., 1.6 g/kg/body mass daily or less). Whether a polarized, pyramidal, or balanced-intensity training regimen is optimal for endurance athletes is presently unclear. Nonetheless, it is evident that for athletic success in this particular sport, following the traditional models of training or nutrition is not necessary.

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